THE EYE AND ITS IMPORTANCE IN RELATION TO GENERAL DISEASE

Conrad Berens, M.D.
Adolph Posner, M.D.

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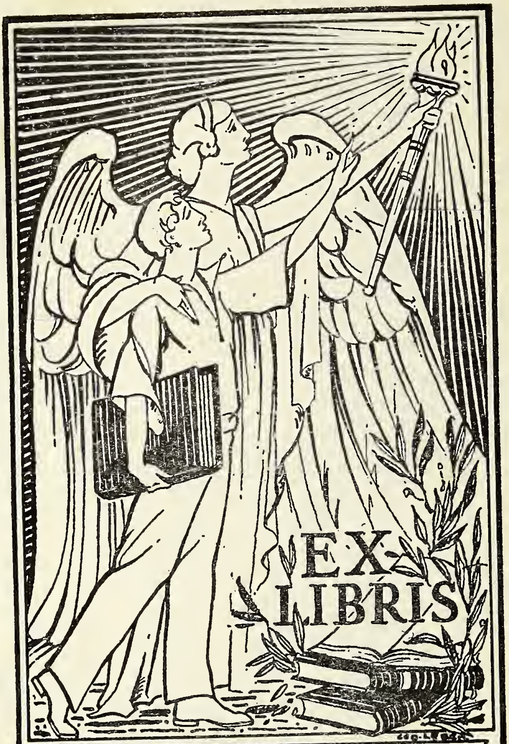

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Eye Health Service
COMMISSION FOR THE BLIND
NEW YORK STATE DEPARTMENT OF SOCIAL WELFARE
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THE EYE AND ITS IMPORTANCE IN RELATION TO GENERAL DISEASE*

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INTRODUCTION

It has long been recognized that the state of health of the body as a whole has a definite effect on the health of the eyes. In this monograph we shall attempt to clarify the interrelationship between general diseases and eye diseases for the reader who has no specialized knowledge in the field of ophthalmology.

The eye presents two specific features which often enable the physician to diagnose diseases in other parts of the body through the study of abnormalities of the eye. Certain diseases of the brain and nervous system manifest themselves in the eye because the eye itself is a specialized outgrowth of the brain. Similarly, many diseases which affect blood vessels in other parts of the body may be recognized in the eye at an early stage since the eye is the one place in the body where blood vessels are not covered by opaque tissues. Not only are the blood vessels of the retina exposed to direct view, but, through the ophthalmoscope, they are seen magnified approximately fifteen times. Eye examination thus makes possible early diagnosis of such diseases as arteriosclerosis (hardening of the arteries), hypertension (high blood pressure), nephritis (kidney disease), diabetes (excess sugar in the blood), and the group of blood diseases named the leukemias, which are characterized by the presence in the blood of an excessive number of white blood corpuscles.

Gross Anatomy of the Eye

A knowledge of the normal anatomy of the eye is helpful in understanding its abnormalities. Component parts which make up the eyeball and are closely associated with it are: the cornea, the three coats of the eyeball, the optic nerve, the crystalline lens, the vitreous and aqueous humors, the eyelids, the conjunctiva, the lacrimal apparatus and the extraocular muscles (Figs. 1 and 2).

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* Aided by a grant from The Ophthalmological Foundation, Inc. made available by the Department of Research, New York Association for the Blind.

The *cornea* (window of the eye) is the curved transparent, tough membrane which covers the iris and pupil. It allows the light to pass through and serves to protect the contents of the eye.

The *sclera*, commonly called the white of the eye, forms the protective outer coat of the eyeball and is continuous with the cornea. The sclera affords attachment for the external muscles which make it possible to turn the eyeball in various directions.

The *iris* is round in shape and varies in color in different individuals. The color of the eye is determined by the amount of pigment. The iris is situated behind the cornea and in front of the *lens*. It encloses a round black opening, the *pupil*, through which light can pass to the *retina* at the back of the eye. The pupil changes in size with variations in intensity of light.

The *vascular* or second coat of the eye, lies directly beneath the sclera and contains the blood vessels that nourish the interior of the eye. This layer consists of three distinct sections which differ structurally from one another. They are the iris, the bulk of the ciliary body and the choroid. The *ciliary body* (Fig. 2) contains the ciliary muscle which alters the shape of the lens so as to enable the eye to focus for distant or near objects. The *choroid* lines the greater part of the eyeball and serves as a source of nourishment for the rods and cones which receive the images on the retina.

The *retina* is the "seeing" layer of the eye. It is the innermost coat and lines the back of the eyeball. The retina receives an inverted image of the object seen by the eye. This image is carried by the optic nerve to the brain where it is interpreted right side up.

The *optic nerve* is the relatively thick stem of nerve tissues which connects the eye with the brain. The optic nerve contains many nerve fibers bound together by connective tissue. The optic nerve itself is surrounded by three sheaths which are continuous with the sheaths of the brain.

The *crystalline lens* which normally is transparent is the magnifiying glass of the eyeball. The lens is situated behind the pupil. As the lens in a camera focuses images on film, so does the lens in the eye focus images on the retina behind it. When the lens of the eye becomes opaque, loss of vision results. This condition is termed a "cataract."

The opacity may be due to injury or disease; the cataractous lens may be removed surgically and vision restored. The lens is made up of concentrically arranged cells. The lens grows continually throughout life by the lengthening of these cells. It has no blood vessels of its own and is nourished by the fluids surrounding it.

The *vitreous* is a substance resembling a colorless jelly; it fills the space in back of the lens (posterior chamber) and maintains the shape of the eyeball. If the nutrition of the vitreous is disturbed or if chronic infection attacks the blood vessel coat of the eye, the vitreous becomes cloudy and the patient becomes aware of floating spots or strands which disturb his vision. Under abnormal circumstances the vitreous may lose its gelatinous consistency and become liquid.

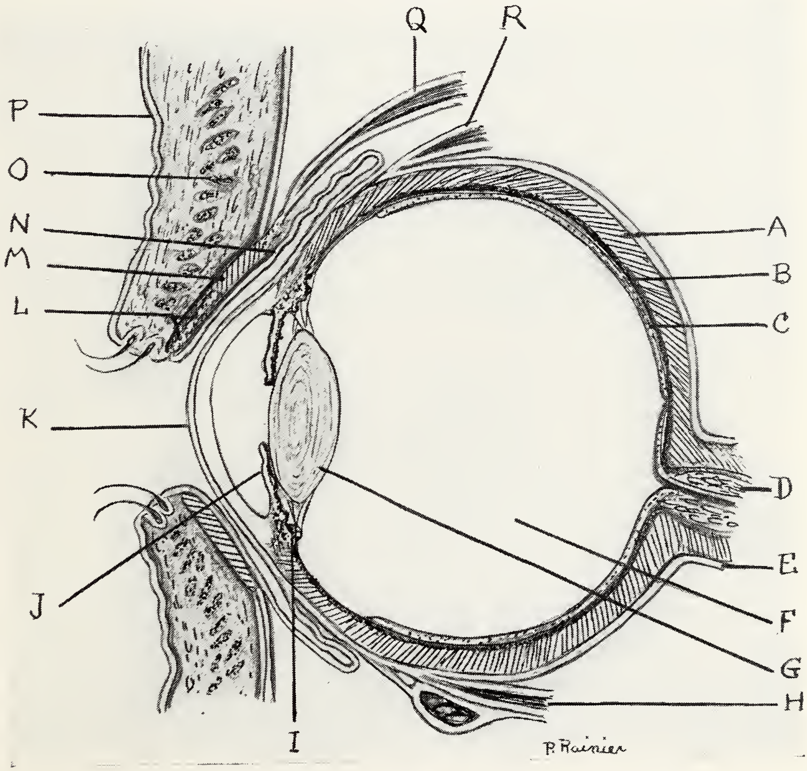

FIG. 1 — Sagittal Section through the Eyeball and Eyelids.
A — sclera; B — choroid; C — retina; D — optic nerve; E — sheath of optic nerve; F — vitreous; G — lens; H — inferior rectus; I — ciliary body; J — iris; K — cornea; L — Meibomian gland; M — tarsus; N — conjunctiva; O — orbicularis muscle; P — skin of the eyelid; Q — levator palpebrae superioris; R — superior rectus muscle.

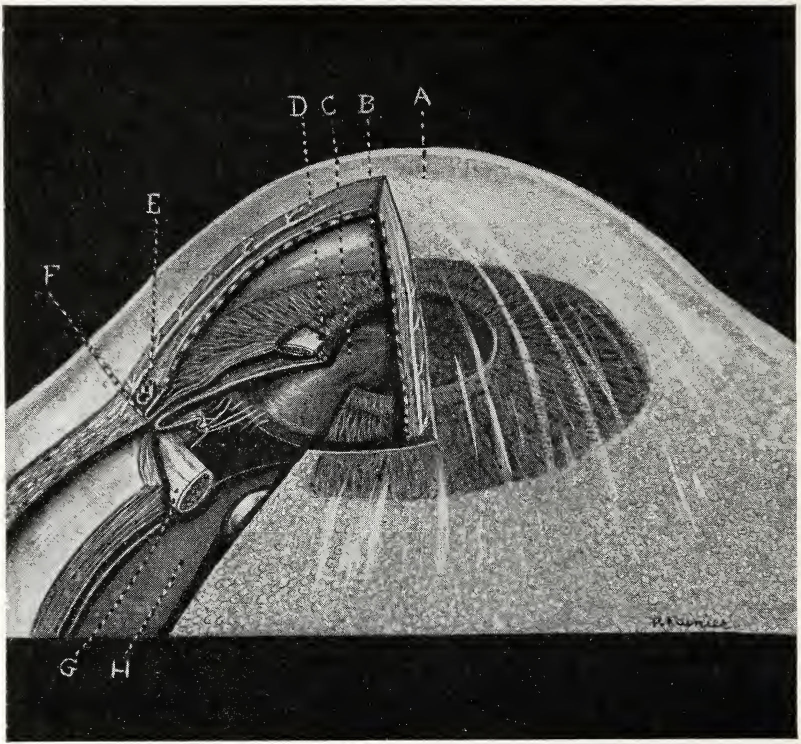

Fig. 2 – Greatly Magnified Section of the Front Portion of the Eyeball. A – cornea; B – iris; C – lens; D – sphincter muscle of the iris, which causes the pupil to contract; E – Schlemm's canal; F – angle of the anterior chamber; G – ciliary muscle; H – vitreous.

The *aqueous humor* is the watery fluid which fills the front portion of the eyeball between the cornea and the lens. The aqueous is formed behind the iris by the ciliary body and passes through the pupil to the space in front of the iris, which is called the *anterior chamber* of the eye. From here the aqueous leaves the eye through the canal of Schlemm and the aqueous veins. These structures, situated within the border of the anterior chamber, are adjacent to the angle formed by the juxtaposition of the iris and the cornea. Interference with the normal drainage of aqueous from the eyeball leads to an abnormal increase of pressure within the globe. Clinically, this state of increased intraocular pressure is known as glaucoma.

The *eyelids* are composed of several layers of tissue. Beneath the skin is the *orbicularis muscle* which closes the eyelids. This muscle overlies the *tarsus*, a plate made-up of dense fibrous tissue, and is shaped to conform with the curvature of the eyeball. The tarsus contains the Meibomian, or grease glands; it also provides the attachment for the muscles which move the eyelids. The muscle which raises the upper eyelid is called the *levator muscle.* It arises deep in the orbit and extends forward above the eyeball to attach to the upper margin of the tarsus.

The *conjunctiva* is the modified skin that lines the inside of the eyelids and extends over the outer one-third of the eyeball. It is composed of an anterior layer of epithelial cells which differ from the epithelial cells of the skin because they do not have a horny substance.

The *lacrimal apparatus* (Fig. 3) is a system of glands and ducts concerned with the circulation of tear fluid. The *lacrimal gland* which produces the tears is situated beneath the outer portion of the eyebrow. Its delicate ducts empty into the upper *fornix* or fold of the conjunctiva. After having discharged its functions of lubricating and cleansing the surface of the cornea, the tear fluid is drained off through the *puncta,* one being located near the nasal corner of each eyelid.

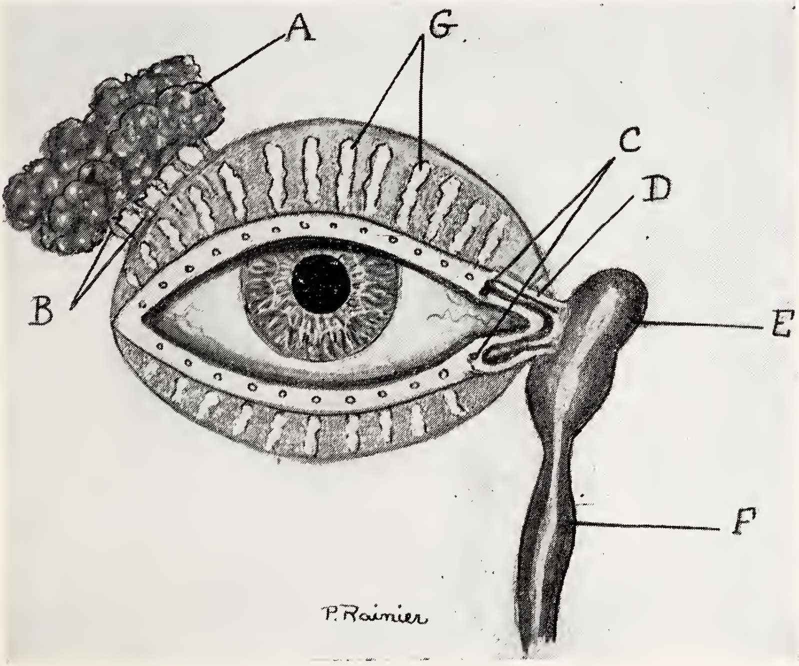

Fig. 3 – The Lacrimal Apparatus. A – lacrimal gland; B – ducts of the lacrimal gland; C – puncta (upper and lower); D – canaliculus; E – lacrimal sac; F – nasolacrimal duct; G – Meibomian glands contained within the tarsal plate.

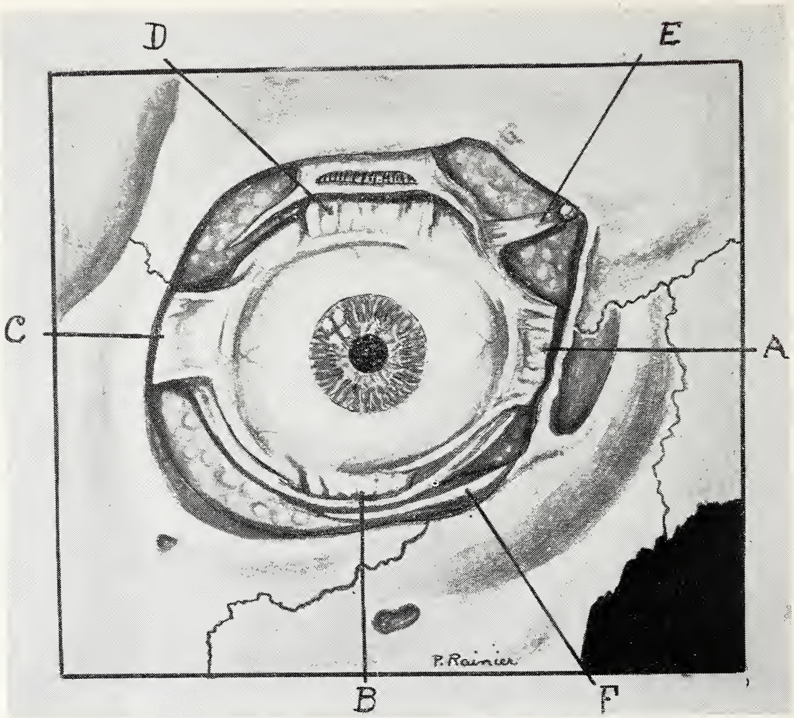

Fig. 4 — Extraocular Muscles. A — medial rectus muscle; B — inferior rectus muscle; C — lateral rectus muscle; D — superior rectus muscle; E — superior oblique muscle; F — inferior oblique muscle.

From here, the tears pass through narrow ducts (*canaliculi*) to the *lacrimal sacs* which carry the tears to the *nasolacrimal ducts* and finally into the nasal cavity. This system of canals accounts for the fact that medicine instilled in the eye is often recovered in the nose and throat.

The *muscles* which turn the eyeball are six in number, four recti or straight muscles and two oblique muscles (Fig. 4). The four recti muscles are: (A) the medial rectus, which turns the eyeball toward the nose; (B) the inferior rectus muscle, which turns the eyeball downward; (C) the lateral rectus, which turns the eyeball toward the temple, and (D) the superior rectus, which turns the eyeball upward. The two oblique muscles are: (E) the superior oblique, which, from the primary position, turns the eyeball downward and outward but rotates the eyeball downward when the eye is turned inward, and (F) the inferior oblique muscle, which, from the primary position, turns the eyeball upward and outward but rotates the eyeball upward when the eye is turned nasally.

The *orbit* is pyramidal in shape and is formed by several bones within the skull. Within the cavity, the eyeball is held in a cushion of fat by the six extraocular muscles. The optic nerve extends backward from the eyeball to pass through an opening in the back of the orbit to connect with the brain.

Embryologic Development of the Eye

The *retina* is the innermost coat of the eyeball, and consists mainly of light sensitive nerve cells. The retina develops as an outpouching to either side of the primitive brain (Fig. 5). Thus, the part of the eye essential for seeing is in reality a specialized portion of the brain. The other parts of the eye (sclera, cornea, conjunctiva, lens and muscles) develop later in embryonal life from the surrounding primitive skin and mesoderm.

Even in the adult individual, the eyeball, while anatomically separate from the brain, is nevertheless connected to it by means of the *optic nerve*. The latter is formed from the primitive optic stalk by the ingrowth of the nerve fibers which carry visual sensations from the retina to the brain.

Anatomic Relation of Eye and Body

While it is true that both embryologically and functionally the eye is intimately connected with the brain, anatomically the eye is a part of the body and must be considered in relation to the body as a whole. For example, the tissues of the eyeball contain numerous blood and lymphatic vessels which are connected with the general blood vessel system and with the lymphatic system which includes the glands of the neck and other parts of the body.

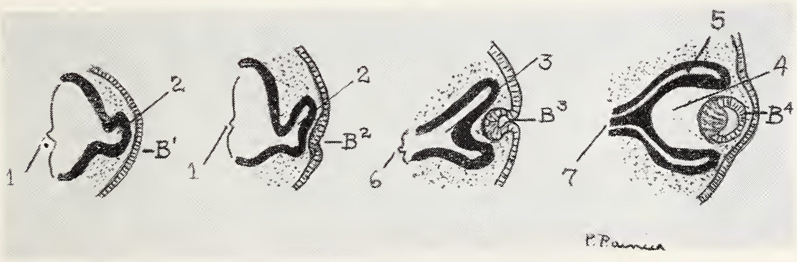

Fig. 5 — Diagrammatic Representation of the Development of the Primitive Human Eye. 1 — cavity of forebrain; 2 — cavity of optic vesicle; 3 — cavity of optic vesicle becoming obliterated by formation of optic cup; 4 — optic cup well formed; 5 — two layers of optic cup; 6 — optic stalk; 7 — optic nerve developing. (After Mann)

One of the more intimate associations that the eye has with the body is in relation to the sinuses of the nose (Fig. 6). On both sides of the *nasal septum* (the central wall which divides the nose into two chambers) the turbinate bones protrude like flaps into the nasal cavities from the medial (inner) walls of the orbits. In the wall of each orbit are hollow spaces known as the ethmoid cells. Behind the ethmoids is the sphenoid sinus, closely adjoining the optic nerve. It is obvious that an inflammation of the sphenoid sinus may cause an inflammation of that portion of the optic nerve which is situated behind the eyeball. In addition to the anatomical proximity between the eyeball and sinuses, these structures are also intimately connected through numerous arteries, veins and lymphatic vessels (the latter carry colorless fluid and white blood cells). It is thus possible for any part of the eyeball to be involved when there is an inflammation of the nasal passages or sinuses.

Symptoms of Eye Diseases and Systemic Diseases

We shall now discuss those symptoms which are caused by abnormal conditions of the eye, and also those eye symptoms which may lead to a diagnosis of systemic disease.

Eye discomfort and headache may arise from any one of various diseases; but the oculist always endeavors to determine first whether the headache arises from an eye disturbance or is a symptom of systemic disease. Most people suffering from headache attribute it to "eyestrain" and usually their first step is to consult an oculist.

What is an eye headache? There is no typical eye headache. The following characteristics lead us to consider the eyes as a possible cause: a headache which is brought on or aggravated by prolonged, concentrated use of the eyes; a headache located over the eyes or around the eyes, or perhaps radiating down the back of the neck. However, even in such an apparently typical eye headache case, we must consider the possibility of systemic causes. The time of occurrence of the headache may be an important clue. If the patient awakens in the morning with headache around the eyes, or above the eyes, and feels better after being up for awhile, the headache may be due to infection of the nasal sinuses.

Following concentrated use of the eyes, a headache which radiates down the back of the neck is often attributable to faulty coordination of the eye muscles. This happens particularly when it is difficult for the patient to focus his eyes on close objects for a long time; the condition is usually caused by weakness of convergence, or convergence

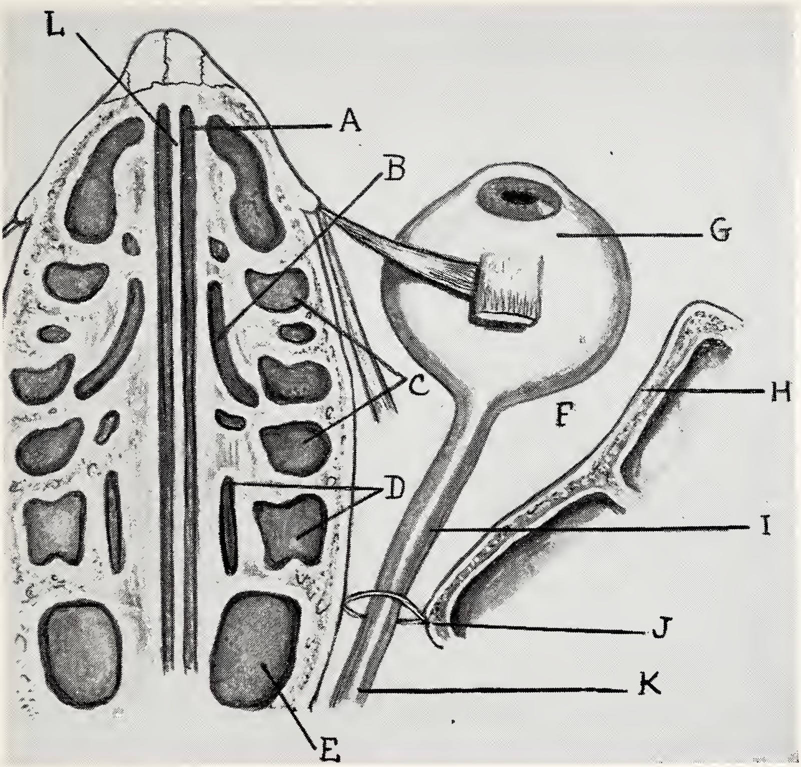

Fig. 6 — Schematic Drawing of a Horizontal Section through the Right Orbit to illustrate the Relation of the Nasal Sinuses to the Eye. A — nasal cavity; B — ethmoid cell; C — anterior ethmoid cells; D — posterior ethmoid cells; E — sphenoid sinus; F — orbit; G — eyeball; H — lateral wall of the orbit; I — optic nerve; J — optic foramen; K — intracranial portion of optic nerve; L — nasal septum.

insufficiency. This is a common condition and a frequent cause of difficulty in using the eyes. *Convergence insufficiency* is often observed in children who return to school after having had no occasion to use their eyes for close work all summer. It is due to rapid fatigue or weakness of the innervational centers of the ocular muscles which cause the eyes to converge.

Headache which comes on in the evening or at twilight should arouse suspicion of possible glaucoma (see angle-closure glaucoma, page 22). It may be brought on by reading, sewing or card playing in dim illumination, or by watching motion pictures. The headache is usually unilateral but may also be bilateral. It may or may not be associated with blurred vision, colored halos and pain in the eye. An examination by an ophthalmologist may fail to disclose the presence of glaucoma, especially when the examination is conducted during morning or early afternoon office hours. For this reason, it is important for the ophthalmologist to suspect glaucoma and to perform special provocative tests. In one of these tests, the patient is placed in a dark room for one hour and this frequently brings on a measurable increase in the ocular tension. When this occurs, the test is called positive and establishes a diagnosis of glaucoma.

Headache may also arise from a systemic infection, such as infection in the nasal sinuses or in the intestinal tract, or from excessive mental or emotional strain. If headache persists over a long period of time, other causes, such as migraine or increased pressure on the brain due to a brain tumor or a head injury, must be considered.

Photophobia is a sensitivity to light. Photophobia may be caused by inflammation of the iris or cornea, or it may be due to irritation of the conjunctiva (the membrane lining the eyelids), or to inflammation along the borders of the eyelids. Photophobia may also signify the need for proper eyeglasses; the excessive use of the muscles of the eye entails a strain which sometimes causes enough congestion and irritation to produce photophobia. Inability to tolerate light is also commonly due to causes remote from the eyes, such as general or focal infections. The focus may be situated in the teeth, tonsils, sinuses, intestines, or other parts of the body.

Lacrimation (excessive tearing) is common and may arise from a simple local abnormality such as narrow, misplaced or blocked drainage channels. Since tearing may be associated with chronic nasal infection, the nose and sinuses should also be examined. In infants, tearing may indicate that the tear duct draining into the nose has failed to open normally. This condition can often be relieved by passing a probe through the tear duct to widen the opening.

Diplopia (double vision) may be monocular or binocular, depending upon whether the patient sees double when using one eye alone, or sees double when using both eyes. The latter is the type which is more often due to serious disease. We occasionally encounter a temporary attack of double vision in school children. This may be due to hysteria or to transient disorders of the eye muscles. Often, double vision indicates disease of the brain such as brain tumors, head injury, epidemic encephalitis, meningitis or syphilis. In older people, the cause may be arteriosclerosis.

Congestion of the borders of the eyelids may be purely local in origin, but it can be associated with other infections, such as sinusitis and infections of the scalp.

Failing near vision (presbyopia) in the adult, normally begins after the age of about 45 years. This is due to progressive loss of accommodation or the inability to adjust the focus of the eye by changing the shape of the crystalline lens. Failing near vision in a child often indicates that he may be troubled by farsightedness (hyperopia). These patients are benefited by properly fitted glasses. Sometimes failing near vision may signalize a more serious condition; it may mean the early stage of sympathetic ophthalmia (inflammation of a healthy eye due to injury of the other) or it may be an early sign of glaucoma. Weakness of accommodation due to diphtheria, anemia, hypothyroidism and syphilis may cause difficulty in reading or other near work.

Failing distance vision in a school child is probably due to myopia or nearsightedness caused by an elongation of the eyeball. Myopia can be corrected by wearing suitable concave lenses. When distance vision fails in the adult, it is commonly due to the fact that his power of accommodation is inadequate to compensate for a farsighted condition (hyperopia). Chronic diseases of the eye, especially cataract (clouding of the lens) and glaucoma (hardening of the eyeball) should also be considered.

Poisoning by tobacco, alcohol and arsenic may produce disturbances of vision from an inflammation of the optic nerve (retrobulbar neuritis). Diabetes and nephritis may produce changes in the retina which result in failing vision (diabetic and renal retinopathy).

Halos are partial or complete rainbow-colored rings or halos around lights. It is a significant symptom in glaucoma. It is not necessarily diagnostic of glaucoma since inflammation of the cornea or an early stage of cataract may also produce this symptom. Rainbows or halos are seen around street lamps on foggy or misty nights by normal eyes.

Nyctalopia (night blindness) is sometimes due to a dietary deficiency, especially the lack of certain vitamins in the diet. At other times it is the chief symptom of retinitis pigmentosa, a disease which may be hereditary or acquired. A disease similar to retinitis pigmentosa may be caused by syphilis.

Micropsia and macropsia mean seeing things smaller or larger than they are. In macropsia objects appear larger, while in micropsia they seem smaller. In the exact center of the retina there is a spot where vision is most acute – the yellow spot or *macula lutea.* The apparent size of an object depends upon the number of seeing elements in the retina (rods and cones) upon which the image of the object falls. If there is a depression in this region, more elements are exposed and the object appears larger. If the yellow spot becomes swollen, fewer elements are stimulated and images appear smaller. This is an especially ominous sign because it may signify disease of this important part of the retina.

Eye Diseases Associated with Certain Systemic Diseases

It is important to realize that many disturbances of the eye may be the result of serious systemic disease. Nevertheless, all eye symptoms should be investigated by an eye physician and treated by him whenever possible.

Herpes zoster ophthalmicus (shingles) is an inflammation of a sensory nerve. It may affect any nerve, but it becomes a concern to the eye physician when it affects the ophthalmic division of the fifth nerve which goes to the eye. Clinically, the disease consists of vesicles (clusters of tiny blisters) surrounded by an area of inflammation. Herpes zoster may involve any structure supplied by the affected nerve, including the skin of the eyelids and forehead, the conjunctiva, the cornea and the iris. The most striking feature of this affection is the severe pain which usually precedes the appearance of the vesicles. The vesicles break, leaving permanently depressed scars. This disease is due to a filterable virus (an organism which is too small to be seen with the ordinary microscope and which passes through a bacterial filter). Since the infection must have portal of entry into the body, the sinuses, which many observers consider of prime importance in this infection, should be carefully investigated. Since the affection is self-limiting, treatment of shingles is largely palliative.

Convergent strabismus (squint) or crossed eyes does not permit the use of both eyes together. If the child uses only one eye and suppresses the squinting eye, he is utilizing only half of the potential seeing ability of his brain. In addition, when one eye is used to the exclusion of the other, vision may fail in the unused eye *(amblyopia ex anopsia)*. As soon as a child is known to have convergent squint, he should be examined by an eye doctor.

Squint may be caused by disease of the brain, the nervous system, or the eye, and a diagnosis can be made only after a thorough examination. Fortunately, many squints are due to an optical defect and can be corrected by the use of suitable convex or plus lenses. In some cases, eye exercises in addition to the use of lenses are beneficial. A common belief, which has been shown to be erroneous, is that a child cannot wear glasses until the age of three or four years. When necessary, glasses can be worn by children a year old or even younger. Another fallacy is the belief that these children cannot be operated upon until they are thirteen or fourteen years old. One should always consider the psychological handicap under which these children labor if operation is delayed until they are "teen-agers." An even more important reason for surgery at an early age (two or three years old) is the fact that both sides of the brain are permitted to develop and binocular vision may be established when the eyes are straightened at an early age.

Divergent strabismus (squint) or walleye is a squint, wherein the eyes turn outward, and is less common than convergent strabismus. When associated with myopia, it may at times be corrected by properly adjusted glasses. One should always search for other possible underlying causes, such as malnutrition, disease of the brain, of the deeper parts of the eye, or of the other skeletal muscles of the body. When the oculist is certain that nonoperative measures will not suffice, operation should not be delayed.

Chalazion is a circumscribed tumor or lump in the eyelid caused by inflammation of the Meibomian glands. Other causes outside the eye are sometimes responsible. Recurring multiple chalazia in chronically inflamed eyelids are often associated with an infection in the nose. When the cause can be removed, treatment is facilitated. When inflammatory signs are pronounced, the swelling will sometimes subside spontaneously. If painful, it should be opened and treated like an abscess in any other location. Occasionally, the instillation of suitable eye drops will effect a medical cure by opening the ducts and permitting the retained secretion to be discharged. It is important to treat the other Meibomian glands, since the infection of one gland may indicate a dysfunction of other glands in the eyelids.

Dacryocystitis is an inflammation of the tear sac. Normally, tears are drained through the tear duct into the nose. Along its entire course, this duct is in close relation to the nose and sinuses. For this reason, tearing often accompanies sinus infection. The tearing is produced by a diminished outflow due to constriction of the tear duct, combined with an increased secretion caused by irritation of the nerves which supply both the sinuses and the tear glands. Therefore, in most of these cases, the underlying causes must be treated. The condition may sometimes be relieved by passing a probe through the tear duct, but this form of treatment must be used with caution and skill.

Conjunctivitis is an inflammation of the conjunctiva. It may affect chiefly the part which lines the eyelids, or the part which covers the eyeball, or both. Depending upon the severity of the inflammation, symptoms vary from mild discomfort and fatigue in using the eyes, to pain and inability to open the eyes. A mucous or mucopurulent discharge is characteristic of conjunctivitis. Frequently, conjunctivitis is associated with an infection of the nose, sinuses, or upper respiratory tract. Conjunctivitis also accompanies many acute contagious diseases, especially measles. If the conjunctivitis is limited to one eye, the cause may be an infection of the tear duct or tear sac. In most cases, conjunctivitis is caused by bacteria and can be treated effectively with local and systemic use of modern antibiotics.

Acute epidemic keratoconjunctivitis is a particularly severe form of conjunctivitis caused by a virus. It occurs in epidemics and frequently leaves punctate scars in the cornea of one or both eyes. This infection is resistant to all forms of treatment and can spread rapidly among workers in the same factory or office. During an epidemic, the disease is apt to be transmitted through public swimming pools. The most important measure for controlling the disease is early recognition and isolation of the patient so that he will not transmit the disease to others.

Phlyctenular keratoconjunctivitis is characterized by an inflammation of the conjunctiva and of the cornea. The cause has not been definitely determined but it is often associated with marked eczema of the scalp. The eye lesions consist of little pimples on the conjunctiva and cornea, and most characteristically, at the border between conjunctiva and cornea. Children affected by this disease often suffer from chronic nasal catarrh. For this reason some eye physicians have attributed the disease to chronic infections in the nose. From experimental work on animals, certain investigators have implicated other factors, such as excess sugar in the diet and other dietary faults. Phlyctenular conjunctivitis has been known to be caused by tuberculosis. It is essential not to overlook any possible factor.

Gonorrheal conjunctivitis in the newborn is a disease commonly known as ophthalmia neonatorum (inflammation of the conjunctiva in the newborn). The name, however, is misleading for not all ophthalmia in the newborn is due to the gonococcus. The gonorrheal variety can lead to scarring of the cornea, or even loss of the eye. Many mild cases of conjunctivitis in the newborn are caused by one or another of numerous nonvenereal bacteria and viruses. Fortunately, by simple precautionary measures at birth, ophthalmia neonatorum is successfully controlled in most countries. The National Society for the Prevention of Blindness and similar organizations throughout the world are largely responsible for disseminating information concerning control of the disease and for the passage of laws for mandatory prophylactic measures at birth.

Interstitial keratitis is an inflammation of the cornea, usually due to congenital syphilis. It may begin in one eye, but eventually involves the other eye, regardless of the type of treatment employed. The introduction of penicillin and other antibiotics has improved the possibilities for both prevention and treatment of this condition. It is essential to bear in mind that the patient with interstitial keratitis may have a dental or other infection, which may act as a contributing cause.

Scleritis is an inflammation of the sclera (the tough outer coat of the eyeball) and is characterized by congestion or a nodule in the sclera. If the inflammation is superficial (in the episclera), it is called *episcleritis.* If it is deep, it is known as a true deep scleritis. The causative factor is obscure but the disease may be due to tuberculosis, leprosy, arthritis, syphilis, as well as other chronic infections, the so-called focal infections.

Uveitis is an inflammation of the uveal tract which is the blood vessel coat of the eye and consists of three segments, namely the choroid, ciliary body and iris. Inflammation of the choroid (choroiditis) is frequently present simultaneously with inflammation of the iris or ciliary body.

Choroiditis usually produces no pain but is accompanied by more or less pronounced blurring of vision. During the acute stage, an inflammatory swelling can be seen in the fundus with the ophthalmoscope. In the course of time, the inflammation subsides and the scar which forms involves not only the choroid but also the overlying retina; hence the disease is also known as *chorioretinitis.* These inflammations tend to recur, usually in the same eye. In some cases, chorioretinitis is associated with general diseases such as rheumatoid arthritis, toxoplasmosis, tuberculosis and syphilis or it may result from focal infections, especially infections of the teeth and nasal sinuses. Except in patients with tuberculosis, cortisone and related substances are very useful in controlling the acute phase of the disease and in preventing loss of vision.

Cyclitis, or inflammation of the ciliary body, gives rise to pain, especially on focusing or looking at strong lights. The pain is caused by spasm of the ciliary muscles. Both the sclera and conjunctiva are reddened (injected), but the characteristic sign is a ring of redness, or "ciliary injection" surrounding the cornea. This ring corresponds to the position of the ciliary body within the eyeball. Cyclitis usually does not occur alone but in combination with iritis.

Iritis is an inflammation of the iris. The usual symptoms of iritis are pain in the eye, photophobia, tearing and dimness of vision. The inflamed iris appears dull and differs in color from the normal eye. The pupil is contracted and does not have the normal round shape; there is redness of the conjunctiva, especially in the region surrounding the cornea.

An advanced stage of severe iritis is shown (Fig. 7). The lens becomes opaque, the iris is bound to the lens by adhesions, and glaucoma may ensue as a complication. Sometimes an opaque membrane covers the pupil which has to be cut in order to enable the patient to see.

In many cases exhaustive investigation fails to reveal the cause of iritis. Iritis has occurred in association with tuberculosis, syphilis, rheumatism, gonorrhea, diabetes, dental and nasal infections, and other systemic diseases.

To avoid complications, it is important to recognize iritis early and to observe and treat it for a long period of time. In the treatment of iritis, cortisone and related substances are generally effective in relieving symptoms and preventing serious complications. The prognosis in cases of iritis is now more favorable than before the discovery of cortisone just a few years ago. During the acute phase of iritis, it is essential to keep the pupil dilated with atropine in order to break away existing adhesions and to prevent formation of new ones. Figure 7 shows a dilated pupil which is bound to the lens by adhesions at several points.

Retrobulbar neuritis is an inflammation of that portion of the optic nerve which is situated behind the eyeball. The inflammation may be so severe that it extends to that portion of the optic nerve within the eyeball where it can be observed through an ophthalmoscope. When this condition is present, it is called *papilledema* or swelling of the optic nerve head. In other cases, diagnosis is difficult because the inflammation of the nerve behind the eyeball may be mild and no change can be detected in the appearance of the head of the optic nerve, which is the only portion of the nerve accessible to visual examination with the ophthalmoscope. Patients who have retrobulbar neuritis commonly complain of poor vision one day and better vision the next, or they may have attacks of blurred vision lasting only a few moments. Retrobulbar neuritis is more commonly seen between 10 and 20 years of age. It may be one of the first symptoms of *multiple sclerosis.*

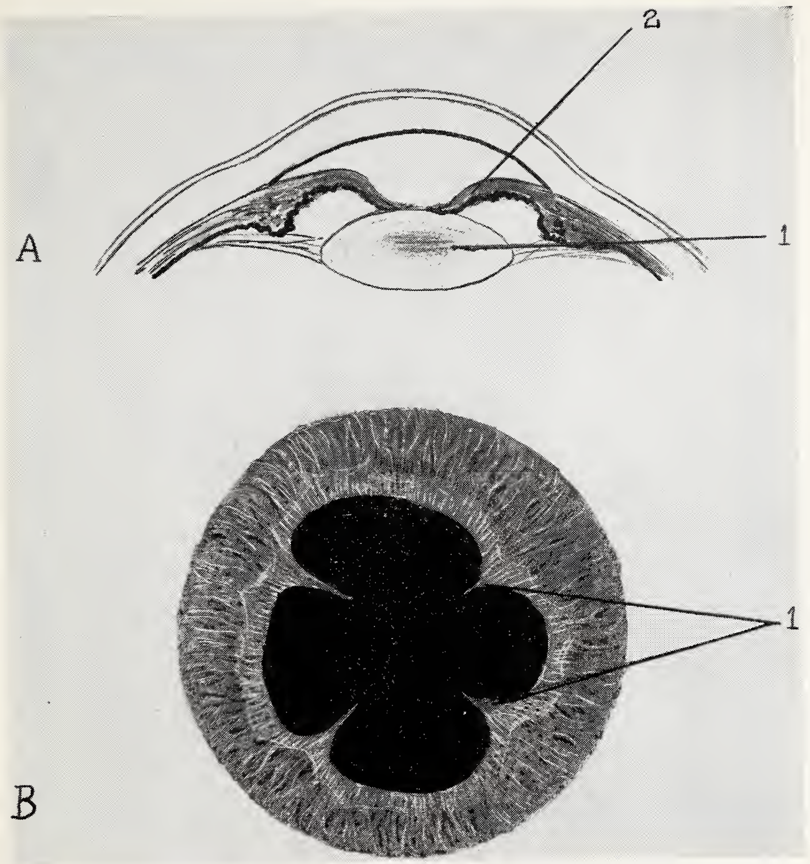

Fig. 7 — A — The End-Result of Iritis. 1 — lens covered by a dense white membrane which is opaque to light; 2 — iris bound down to lens along the entire pupillary and bulging forward due to increased pressure behind. B — Iris was dilated with atropine. 1 — strands of iris tissue adherent to anterior surface of the lens (posterior synechiae).

Glaucoma is a condition in which the fluid pressure within the eye is abnormally elevated. The fluids which are concerned with this increase in intraocular pressure are the aqueous and vitreous. The pressure within the blood vessels of the eye is not directly concerned with the production of glaucoma. Hence, glaucoma bears no direct relationship to increased blood pressure. The coats of the eyeball normally are subjected to a definite intraocular fluid pressure. This varies from one individual to another and also varies with the time of day and other physiologic factors. The normal range of intraocular pressure is between 12 and 25 mm. of mercury. It is this intraocular pressure which maintains the eyeball in its normal almost spherical shape and which prevents it from collapsing. We have no means of measuring this pressure directly in a patient. We can, however, make a fairly accurate estimation of the pressure by measuring the hardness or tension of the eye. We call this the measurement of ocular tension, as contrasted with intraocular pressure. Ocular tension may be measured crudely by placing two fingers on the patient's closed upper eyelid and noting the degree of indentation which can be produced by a moderate amount of finger pressure on the eyeball. While palpation may be used to differentiate a very soft from a very hard eyeball, it is unsatisfactory for detecting an early case of glaucoma. The standard method for measuring the ocular tension employs an instrument called a *tonometer.* The most widely used of several instruments is the Schiötz tonometer. With the patient in a prone position and gazing directly upward, the tonometer, held vertically, is placed on the cornea, which has been made insensitive by the instillation of one or two drops of a local anesthetic. The degree of indentation of the cornea is measured on the scale of the tonometer, and represents the relative hardness or softness of the eyeball. The reading obtained with the tonometer is then converted into the actual intraocular pressure. A simplified variation of this tonometer, for the use of general practitioners and others interested in the detection of glaucoma, is the Berens-Tolman Hypertension Indicator. This instrument is recommended for use in glaucoma detection programs by the National Society for the Prevention of Blindness and other organizations interested in preventive medicine.

Angle-closure glaucoma is a type of glaucoma due to a peculiarity of the structure of the eye. In recent years, the knowledge of glaucoma has made considerable progress. We differentiate between two distinct types of glaucoma: *angle-closure glaucoma* and *chronic simple* (*open-angle glaucoma)* as illustrated (Fig. 8). In angle-closure glaucoma, the anterior chamber of the eye or the space between the iris and the cornea which is filled with aqueous is shallower than average, and this is particularly true of the peripheral portion of the anterior chamber. This peripheral zone is known as the angle of the anterior chamber. It is bounded behind by the iris and in front by the periphery of the cornea which contains the canal of Schlemm and the trabecular meshwork, the sieve through which the aqueous filters out of the eyeball and into the canal of Schlemm. A narrow angle of the anterior chamber predisposes to angle-closure glaucoma. The measurement of the width of the angle and a study of other factors of this important feature of the eye has been made possible by a special technique known as *gonicoscopy.* In this technique, we employ a special type of contact lens. Under certain conditions, the angle of the anterior chamber may become so narrow that the iris occasionally comes forward and touches the posterior surface of the cornea (Fig. 8). In this manner, the iris blocks the circulation of the aqueous, and it especially prevents the aqueous from reaching the angle of the anterior chamber, the space from which the aqueous normally drains into the canal of Schlemm. When the angle becomes blocked or closed, the pressure within the eye rises and glaucoma results. The pressure may be increased to levels as high as 60 or even 100 mm. of mercury. The fluid under high pressure compresses the blood vessels and nerves within the eyeball and thus produces loss of vision. When the blood vessels are compressed for any considerable time, some parts of the eye are rendered bloodless and the resulting inflammatory swelling of the tissues causes severe pain in the eye, redness, steaminess and greenish discoloration of the cornea, headache, nausea and vomiting. This group of symptoms and

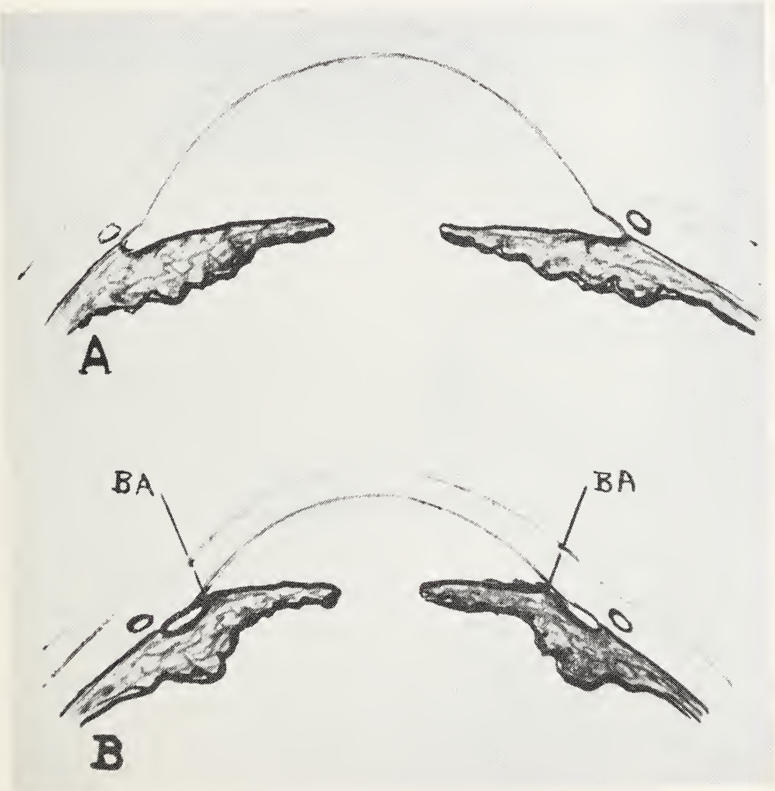

Fig. 8 — Schematic Representation. A — open-angle glaucoma; B — angle-closure glaucoma — BA shows a blocked-angle.

signs characterizes an *acute congestive attack of glaucoma.* It is from the steamy, greenish cornea that the name glaucoma is derived. The word "glaukos" in Greek means "sea green." When a patient has these severe symptoms, he naturally seeks the aid of a physician and frequently sight can be restored and further progression of the glaucoma may be prevented by the use of medication or by surgery.

Unfortunately, in many cases typical symptoms of pain and blurred vision are absent for a long time and this is true even of angle-closure glaucoma. The patient may have some vague symptoms such as tearing, difficulty in reading, and seeing of colored halos around lights. These symptoms warrant careful investigation by the ophthalmologist to rule out the possibility of glaucoma. Occasionally, an acute attack, or at least a rise of intraocular pressure, is produced inadvertently by the use of drops to dilate the pupil as is frequently done for an examination of the fundus or for refraction. In this case, the discovery of an otherwise undetected glaucoma may be considered a boon to the patient. In the treatment of angle-closure glaucoma, the important principle is to keep the pupil as small as possible through the use of eye drops such as pilocarpine. In this way the iris is kept taut and is prevented from blocking the angle of the anterior chamber. When medical treatments fails to maintain the pressure at a normal level or to prevent recurring acute attacks of glaucoma, an iridectomy is performed. This is an operation in which a piece of the iris is removed so as to allow the aqueous behind the iris to communicate with the aqueous in the anterior chamber in front of the iris.

Chronic simple glaucoma (open-angle glaucoma) is found in approximately 75 percent of glaucomatous eyes. Here, the intraocular pressure is abnormally elevated but the angle of the anterior chamber remains anatomically open. We do not know what causes the glaucoma but we know that in the later stages of the disease there is present a scarring of tissue which lies between the anterior chamber and the canal of Schlemm. Most of the pores through which the aqueous normally passes to get out of the eyeball and into the canal of Schlemm are either occluded or absent. If the intraocular pressure continues to be elevated for months or years there occurs a progressive deterioration of vision affecting mainly the peripheral field of vision. Central vision also becomes affected but usually at a later stage. With the ophthalmoscope, one is able to detect a characteristic change in the appearance of the optic nerve head. The normal nerve head appears as a pinkish disc, on the same level with the fundus, and lies somewhat nasal to the macula. The nerve head represents the point where the optic nerve leaves the eyeball. This is also the place where the artery and vein to the retina enter the eyeball. In glaucoma, the nerve head, being the least resistant portion of the wall of the eyeball, becomes pushed out by the abnormally high intraocular pressure. At the same time, the minute blood vessels contained in the supporting tissue become compressed and eventually obliterated. These two factors together result in a pale nerve head which appears cupped or excavated (Fig. 9). Glaucomatous cupping of the optic nerve head is an important sign of long standing glaucoma. Unfortunately, it is a late sign and is of little help if we are to diagnose glaucoma in the early stage.

Treatment of glaucoma requires continual medical supervision. Chronic simple glaucoma, one of the important causes of blindness, still remains shrouded in mystery. Much research is being carried on in various parts of the world to discover and to eliminate the causes

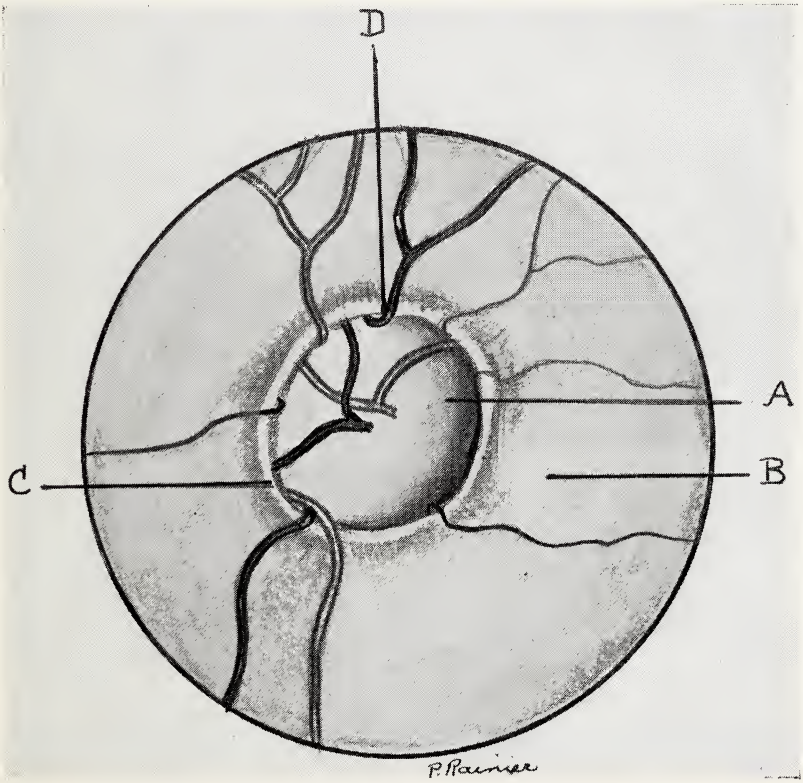

Fig. 9 — Optic Disk in Glaucoma (schematic). The drawing illustrates the cup-shaped depression of the disk: A — with reference to the rest of the fundus B — the sharp margin C — of the optic nerve projects into the lumen of the cup and the blood vessels D — bend sharply outward as they emerge from the cup.

of this form of glaucoma. For the present, early diagnosis and early institution of treatment are the most important means at our disposal in the prevention of blindness. It is also essential to follow the patient for the rest of his life even after the pressure has been brought under control. The medical treatment involves the use of various eye drops, some being more effective than others, depending upon the case. Recently, drugs have been introduced which, taken by mouth, lower the intraocular pressure. These drugs are of great value in controlling those cases in which the intraocular pressure is not greatly elevated and they also make it possible to postpone surgery until the patient has been thoroughly studied and has had a chance with the various types of medical treatment. When surgery becomes necessary, it should not be delayed since any loss of vision caused by glaucoma is not recoverable. The most important single feature in determining the necessity of either surgery or more vigorous treatment is the progressive loss of *visual field*. The visual field is the sum total of all points which form images on the retina. It is usually impracticable for the patient to measure his own visual field because most of it involves side vision (indirect vision). For this reason, methods and instruments have been devised and are in use by ophthalmologists for measuring and plotting accurately the peripheral extent of the field and any defects or blind spots (except for the normal blind spot which corresponds to the entrance of the optic nerve into the eyeball). If the visual field shows progressive deterioration, operation is indicated. The ophthalmologist has the choice of several operative procedures for the control of pressure in glaucoma. Most of these procedures are designed to improve the outflow or drainage of aqueous from the eyeball. They consist in forming artificial openings which permit aqueous to leave the eyeball and join the general blood circulation. These openings replace the normal filtering openings into the canal of Schlemm which have become ineffectual. The operations are known by various names such as iridencleisis, sclerectomy, trephine and cyclodialysis. Other procedures are designed to diminish the formation of aqueous by producing changes in the ciliary body where the aqueous is normally formed. The most important of these procedures are cyclodiathermy and cycloelectrolysis.

In the treatment of glaucoma, we must not forget the role played by the general physiologic processes of the body. Many chronic infections as well as disturbances of metabolism can aggravate a glaucomatous eye. It is even possible that glaucoma may be caused by disturbances of the liver and kidney function. There is evidence to show that during certain stages of glaucoma, the function of liver and kidney is impaired. A thorough work-up of a patient with glaucoma should therefore include complete physical examination and laboratory tests to rule out any possible systemic disorder.

A patient with glaucoma requires the utmost care and consideration from the ophthalmologist, the internist and the patient's family. The psychologic factors should not be overlooked, particularly since the partial or progressive loss of vision may entail the necessity for readjustment and rehabilitation. In handling clinic patients and patients who do not fully understand the seriousness of the condition, an efficient social service follow-up is of utmost importance.

Secondary glaucoma may be caused by uveitis, injuries, hypermature cataracts, etc. The two types of glaucoma discussed above, namely angle-closure and chronic simple glaucoma, are known collectively as *primary glaucoma.* This term differentiates them from so-called "secondary glaucomas" in which the increased ocular tension is caused by some other disease or disturbance of the eye. In the treatment of secondary glaucoma, our chief concern is with the condition which causes the glaucoma. This, if possible, should be removed. If the glaucoma is not thus alleviated, it is treated in a manner similar to primary glaucoma.

Congenital glaucoma is present at birth and is caused by a congenital anomaly of the eye which consists either of the absence of Schlemm's canal or the presence of abnormal tissue which prevents the aqueous from reaching Schlemm's canal. Since the coats of these infants' eyes are thin and resilient, they stretch under the increased intraocular pressure. Within a short time, the eyeball may become extraordinarily large and this unusual appearance of the eye with congenital glaucoma has caused it to be called *buphthalmos* or "*ox eye.*" In recent years, the treatment of congenital glaucoma has been much more successful than formerly. A new operation known as goniotomy is frequently successful in reducing the pressure and preventing further enlargement of the eye and loss of vision.

Cataract is an opacity of the crystalline lens. Normally, the lens is perfectly transparent. If it loses any of its transparency, a cataract is present.

When a cataract is present at birth, it is called *congenital cataract.* It may vary in appearance, but the most frequent type is the lamellar cataract (Fig. 10). It is characterized by a white opacity in the center of the pupil. Since the tendency to congenital cataract may be hereditary, it is unwise for an affected individual to marry into a family which has any history of hereditary cataracts. Of the 7,989 pupils in the

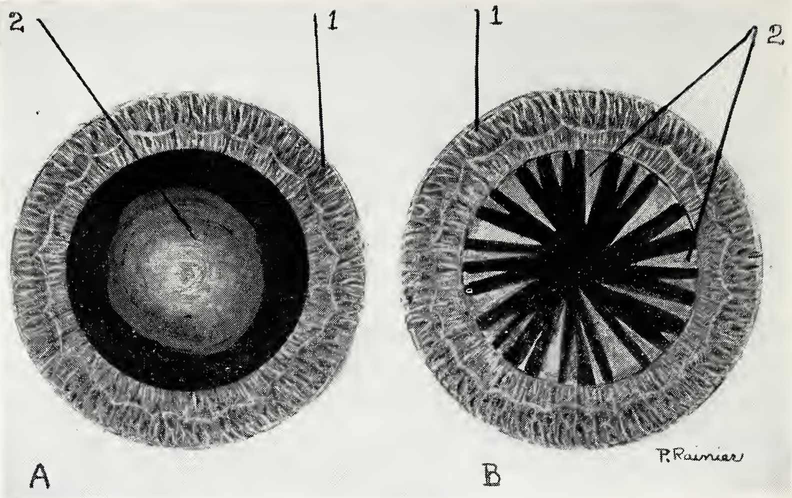

FIG. 10 — A — Lamellar Cataract (congenital). 1 — iris; 2 — central cloudy (cataractous) portion of lens. B — Incipient Senile Cataract. 1 — iris; 2 — spoke-like opacities in the outer layers of the lens.

United States residential and day schools for the blind, 10.3 per cent are blind as a result of congenital cataract.*

German measles, occurring in the first three months of pregnancy, may result in congenital cataracts.

Another type of cataract is the *senile cataract* which develops in people past middle age. Figure 10 shows the incipient stage of senile cataract. It is probable that age is not the most important factor in the causation of cataract, but that the patient's general condition plays an important role.

An injury to the eyes may be followed by the formation of a cataract. The immediate cause of this type of cataract is a tear or rupture of the capsule enclosing the lens. This is called a *traumatic cataract*.

A cataract cannot be dissolved since the opacity of the lens is due to the presence of degenerated lens fibers. In the incipient stage the process of degeneration may possibly be retarded under appropriate general treatment. Once the cataract has become mature and the lens opaque, vision can be restored by surgical removal of the lens.

Allergy of the eye is characterized by the following symptoms: excessive tearing, itching, photophobia, redness and congestion of the conjunctiva and puffiness of the eyelids. The most common and most typical example of allergy of the conjunctiva is the conjunctivitis which accompanies hay fever. In the case of hay fever, the eye symptoms are seasonal and are best prevented or treated by removal of the offending specific pollen.

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* Statistics through the courtesy of the National Society for the Prevention of Blindness.

Allergy of the conjunctiva and eyelids may also occur as a result of sensitivity to such general agents as dust, feathers, smoke, and food; or it may result from contact with soaps, cosmetics, or medications. Allergic manifestations may not set in until after prolonged use of a chemical or biologic agent because it takes time for sensitivity to develop. Other conditions of the eye, such as keratitis and iritis, may in some cases be caused by allergy.

In the treatment of allergic conditions, it is most important to determine, if possible, the causative factors and remove them. Unfortunately, in many instances, this cannot be accomplished. In recent years, two new groups of drugs have been introduced for the nonspecific treatment of allergic conditions. These are the antihistaminics and the cortisone-like substances. Through the use of these chemicals, patients can be made much more comfortable; and, in some cases, the allergic manifestations can be completely controlled.

Injuries of the eye require prompt attention and care. It has been estimated that approximately 17,000 people in the United States are totally blind as a result of industrial injuries, trauma or carelessness in the home, and that at least an additional 170,000 persons have lost the sight of one eye.* A large percentage of these accidents could have been avoided or prevented by exercising common sense and removing hazards. Industry has taken measures to prevent injury, but these require the cooperation of the individual who tends to be careless or ignores the safety measures provided.

Frequently, immediate first aid following injury may do more to prevent loss of vision than delayed expert medical treatment. For this reason, the following first aid treatment for various types of injuries, followed by examination of an ophthalmologist, is recommended:

Foreign bodies which cannot be easily flushed or wiped from the eyelid, but are embedded in the eyeball can be serious. The eye should be patched, moved as little as possible, and an ophthalmologist consulted immediately.

Alkaline burns are caused by plaster or lye. The eye should immediately be washed carefully with water and later neutralized by flushing the eye with a solution of a tablespoon of vinegar diluted in a glass of water.

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* Statistics through the courtesy of the National Society for the Prevention of Blindness.

Acid burns require that the eye be washed copiously with water. To neutralize the acid, follow by washing with a solution made up of one tablespoon of bicarbonate of soda to one glass of water.

Head injuries which apparently do not injure the eyes directly, may nevertheless be followed by either immediate or delayed eye symptoms such as: diplopia (double vision), loss of side vision, protrusion of the eye and sudden reading difficulty. At some time following a head injury, the patient may begin to see *light flashes and floating spots.* These symptoms should be investigated carefully by an ophthalmologist not only at the onset of the symptoms but for some time afterward, since they may be premonitory signs of detachment of the retina. Floating spots are usually caused by physiologic changes in the vitreous humor. Light flashes are caused by traction of the vitreous on the

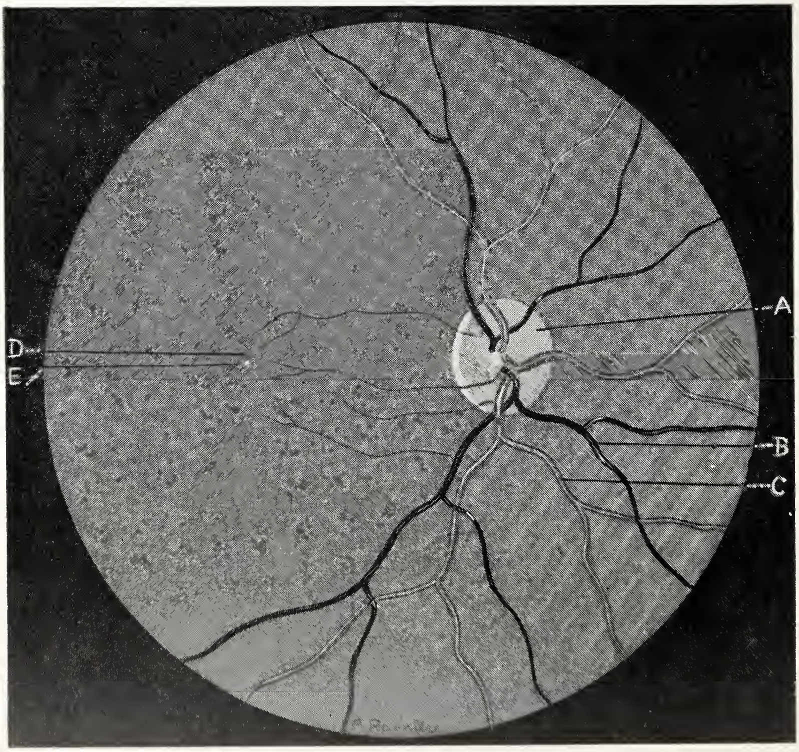


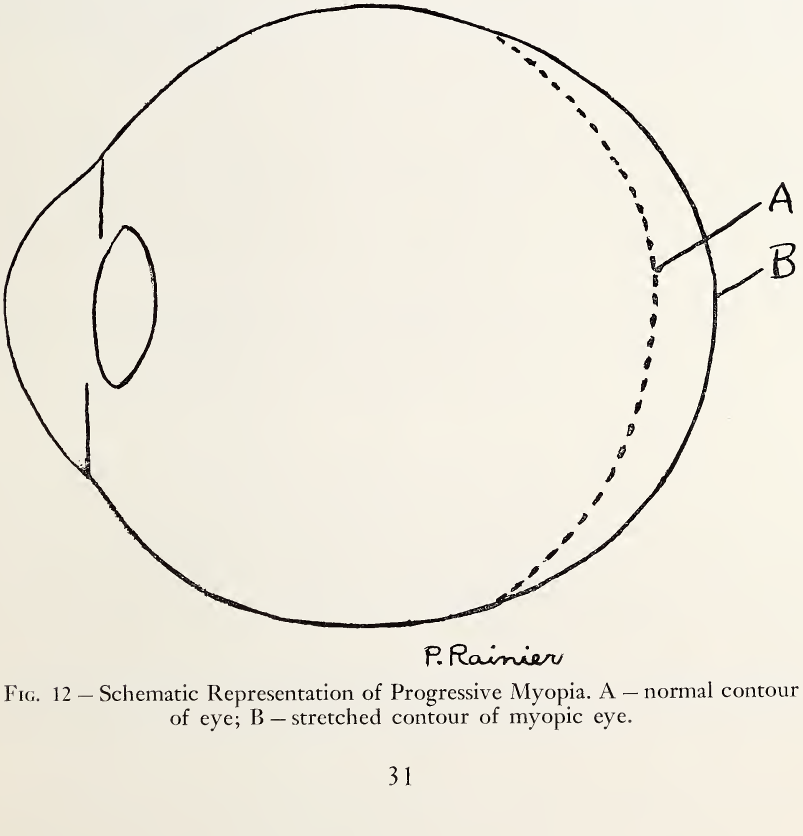
Fig. 11 — The Normal Background of the Eye. A — optic disk; B — branch of vein; C — artery; D — macula lutea or yellow spot; E — fovea centralis.

retina and occasionally this traction is sufficient to cause the retina to tear and to give rise to a detachment.

Subconjunctival hemorrhage is usually a spontaneous hemorrhage and may follow sudden strains and exertions, as in whooping cough, vomiting and physical efforts. It is also seen in blood dyscrasias, nephritis, diabetes, hypertension and injuries. Treatment requires careful examination for fundus pathology and a general medical "work-up." Locally, the absorption of the blood under the conjunctiva may be hastened by the application of heat to the eyeball.

Abnormalities of the Fundus

The normal background (fundus) of the eye, when examined through an ophthalmoscope, has, in life, an orange-red appearance (Fig. 11). From the center of the optic disc (the point of entrance of the optic nerve into the eyeball), the veins and arteries branch out over the entire fundus of the eye. In the exact center of the back of the eye is the macula lutea or yellow spot in the center of which is the fovea centralis, the point of most acute vision.



P. Rainier

FIG. 12 – Schematic Representation of Progressive Myopia. A – normal contour of eye; B – stretched contour of myopic eye.

Myopia (nearsightedness) occurs in the eyeball that is longer than normal (Fig. 12). The usual type of myopia should not be regarded as a disease. Frequently, it is hereditary. Its progression is associated with the growth of the child and stops when the body reaches full maturity. Cases of malignant myopia, a type which progresses beyond maturity, fortunately are rare. The excessive stretching of the eyeball in these cases results in damage to the retina and choroid with consequent visual impairment.

Retinal arteriosclerosis is the narrowing of the retinal arteries caused by thickening of their walls. Irregularity of the diameter of the arteries is a significant early change detected in the fundus. Diseases of the heart, kidney and blood vessels are frequently detected during examination of the fundus with the ophthalmoscope. One of the most important groups of diseases in the entire field of medicine is included under the designation of cardiovascular-renal disease, i.e. disease of the heart, the blood vessels and the kidneys. These three systems are usually classified together because whenever one of these systems is diseased the others tend to be involved.

Recently it has been shown that a diet rich in cholesterol and other fatty substances is a possible factor in causing arteriosclerosis.

The causes of arteriosclerosis have not been definitely determined but in every case a general study of the patient is important.

Diabetic retinopathy (Fig. 13) is caused by diabetes. In diabetes of long duration, the fundus presents a characteristic appearance. Most typical are the pinpoint red spots in the retina which represent microaneurysms, or abnormal dilations of the small blood vessels. Occasionally there are retinal hemorrhages and exudates in the fundus.

Ocular syphilis is a systemic disease of infectious origin. The incidence of syphilis has declined sharply since the introduction of penicillin therapy. Hard chancre (the primary lesion) of the eyelids is now rare. The iris may be affected by syphilis in the secondary and tertiary stages of the disease.

Syphilis may also affect the structures in the fundus of the eye. The retina and the choroid (the blood vessel coat of the eye) usually are involved simultaneously and the result is chorioretinitis. In some cases, syphilitic chorioretinitis takes on a form which simulates retinitis pigmentosa (a progressive hereditary disease of the retina, the cause of which is unknown).

Ocular tuberculosis formerly constituted an important chapter in the diseases of the eye, but its incidence now is much lower because of

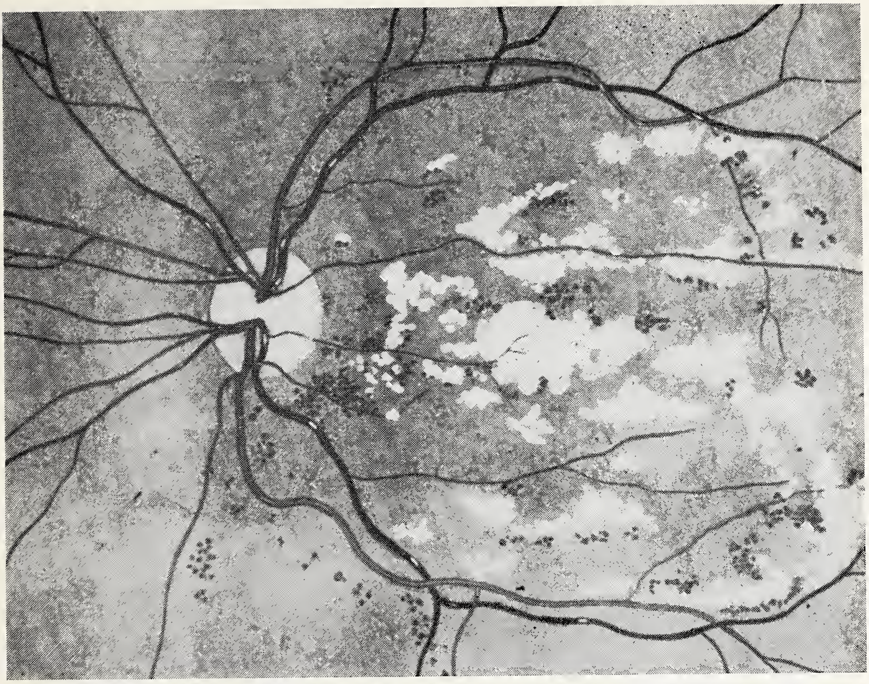


Fig. 13 — Diabetic Retinopathy. Retinal changes show small capillary aneurysms and punctate hemorrhages in the macular area, exudates and constriction of the arterioles and venules.

improved hygiene and effective therapy. Tuberculin skin test is helpful in the diagnosis of tuberculosis and in corroborating the diagnosis of ocular tuberculosis.

Some cases of disseminated chorioretinitis are caused by tuberculosis. This condition is characterized by scattered areas of inflammation affecting the choroid and retina. General medical care and hygiene are important in this disease which primarily affects children.

Toxoplasmosis (Fig. 14) is a disease caused by a unicellular animal organism named toxoplasma. Many cases of chorioretinitis formerly thought to be tuberculosis have in recent years been diagnosed as toxoplasmosis. Toxoplasma produces localized inflammation in the choroid and retina of the embryo causing many cases of impaired vision present at birth. Often the region of the macula is especially affected and presents circumscribed pigmented lesions which cause serious impairment of central vision. Diagnosis may be made by finding, on x-ray examination of the head, small shadows which correspond to calcified nodules of toxoplasmosis in the brain. In adults, the toxoplasma organism may produce either iritis or chorioretinitis similar

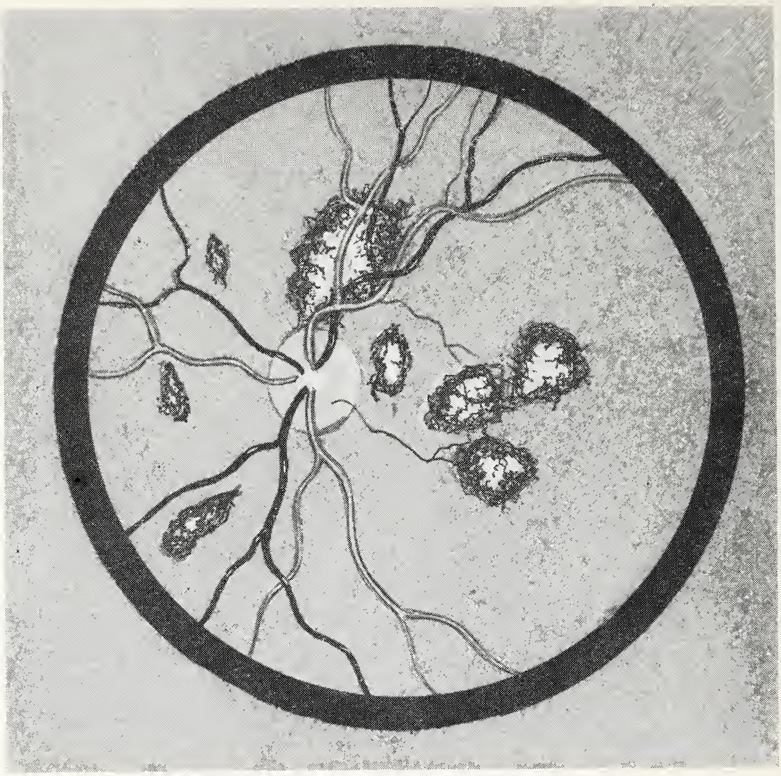


Fig. 14 – A – Chorioretinal Changes in Toxoplasmosis – left eye.

to lesions produced by tuberculosis and other infectious diseases. The diagnosis can be made by means of skin tests and laboratory tests.

Retrolental fibroplasia presents a dramatic story which is unique not only in ophthalmology, but also in medical history. Advance in the design of incubators made it possible to keep alive premature infants weighing two pounds or less by administering oxygen in high concentrations. Paradoxically, it was amoung these well cared for infants that the incidence of retrolental fibroplasia was highest. Many of these infants developed partial or even complete blindness. Through skillful research, which often amounted to clever detective work, the culprit responsible for this affliction was found to be the excessive amount of oxygen administered to the infant in the incubator. The abundant supply of oxygen to the retina removed its need for a blood vessel system as the normal source of oxygen and thus interfered with the natural structural development of the eye. As soon as the cause of

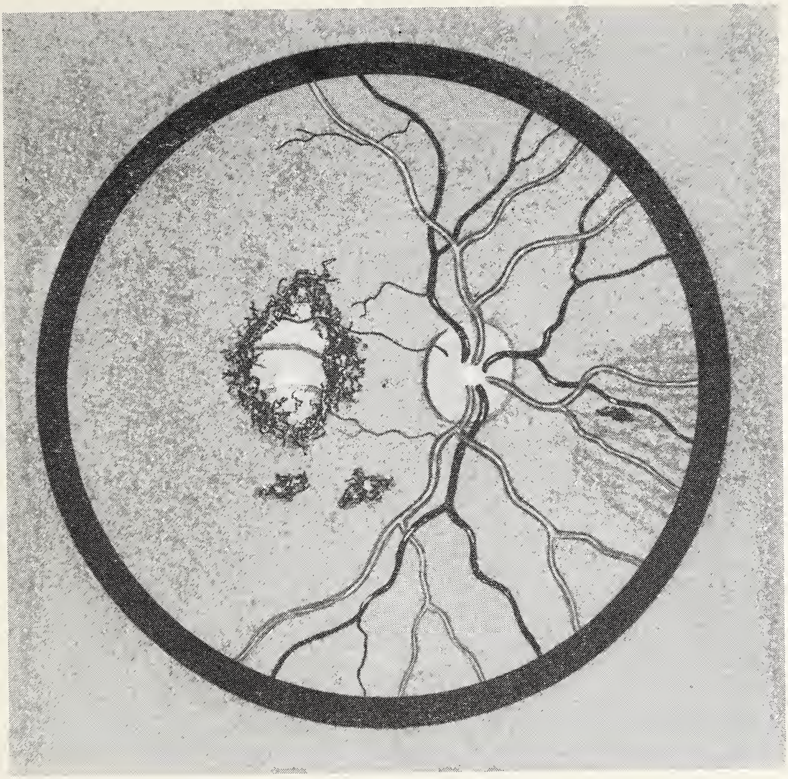


Fig. 14 – B –Chorioretinal Changes in Toxoplasmosis – right eye.

retrolental fibroplasia was recognized, obstetricians and pediatricians teamed up with the ophthalmologists in a coordinated effort to use minimal amounts of oxygen for the shortest possible time for all premature infants.

Statistics show that 8,100 infants in the United States became blind from retrolental fibroplasia. Table I indicates the number of cases of blindness due to retrolental fibroplasia reported in New York State. Note the sharp rise up to 1953 and the dramatic decline of blindness after the causative factor had been discovered. The incidence of new cases of this tragic affliction has been greatly reduced. However, the many children blinded from retrolental fibroplasia continue to require guidance and help.

Conclusion

Every possible factor must be taken into consideration in determining the cause of eye conditions. A thorough, complete physical and laboratory examination including x-ray examination, search for focal infections (teeth, tonsils, sinuses) and allergy tests should be performed to establish the causative factors of an eye disease. Local treatment of the eyes should be combined with treatment of systemic conditions. The eye is not autonomous, but is a part of the body, and is frequently involved in systemic diseases.

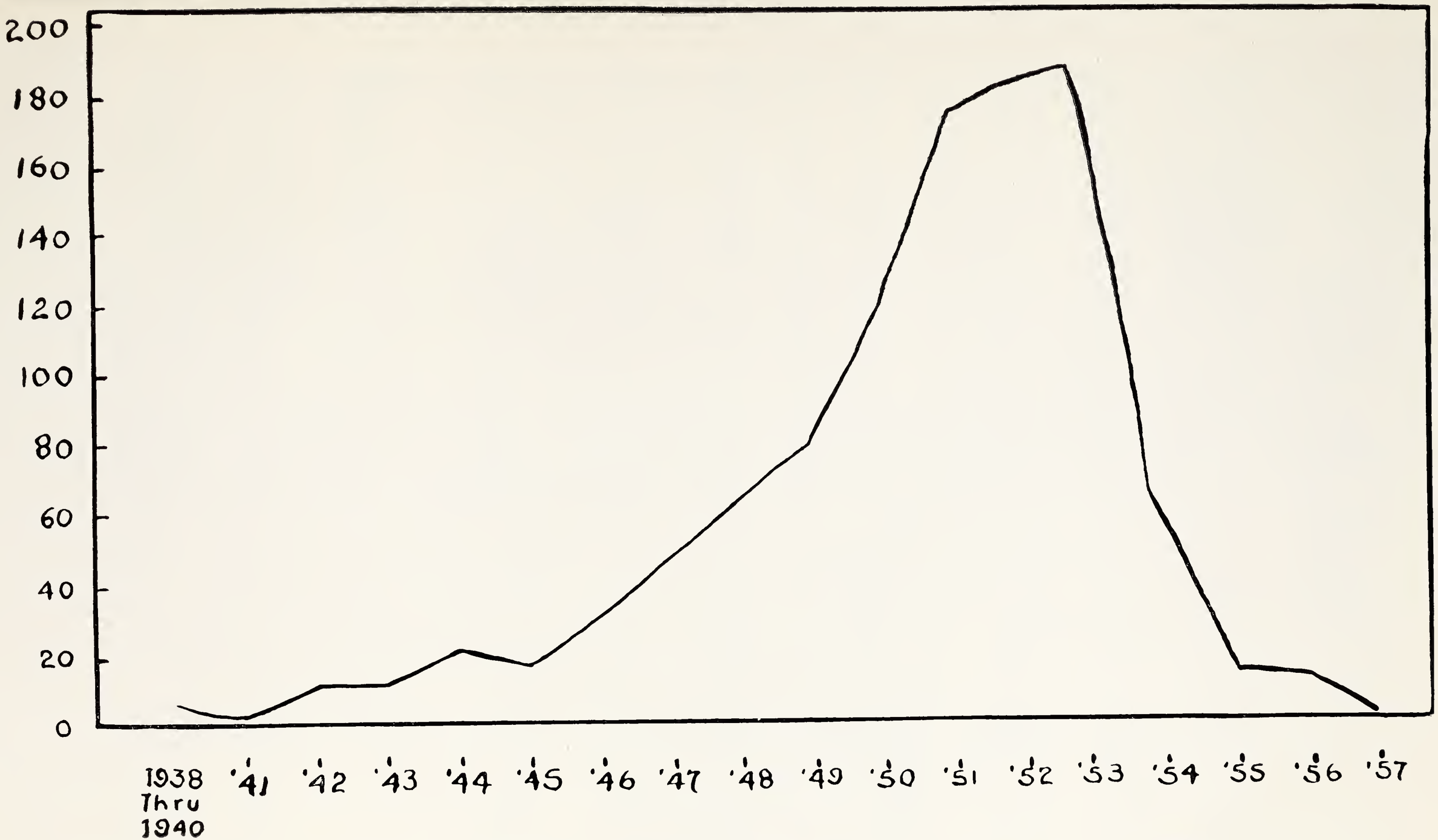


TABLE I – Number of Cases of Retrolental Fibroplasia in New York State Reported to the Commission for the Blind by year of Birth.

GLOSSARY OF TERMS RELATING TO THE EYE AND DISEASES

ACCOMMODATION	The automatic adjustment of the eye for seeing at different distances. Accommodation is produced by changes in the convexity of the crystalline lens.
ALLERGY	Hypersensitivity to drugs, pollens, foods and other agents causing discomfort to the eyes.
AMBLYOPIA EX ANOPSIA	Decreased vision of one eye thought to be caused by nonuse of that eye, usually associated with crossed eyes.
ANGLE OF ANTERIOR CHAMBER	Angle formed by the iris and cornea.
ANTERIOR CHAMBER	Space between the cornea and iris, filled with aqueous.
AQUEOUS HUMOR	The clear, watery fluid which fills the anterior chamber. The aqueous is formed by the ciliary body behind the iris, passes through the pupil and leaves the eye through the angle of the anterior chamber and Schlemm's canal to enter the general blood vessel system.
ARTERIOSCLEROSIS	Hardening and stiffening of the walls of the arteries, occurring mostly in old age.
ASTIGMATISM	A refractive error which exists when parallel rays are not focused at a single point but form as a line in different meridians.
ATROPINE	The active ingredient of belladonna used to dilate the pupil.
BUPHTHALMOS	A globular enlargement of the eye with protrusion of the cornea, the result of congenital glaucoma.

CANAL OF SCHLEMM	A circular duct near the angle of the anterior chamber for the purpose of collecting and discharging the aqueous humor.
CANALICULUS	The narrow duct for drainage of tears between each punctum and the lacrimal sac.
CATARACT	Opacity of the crystalline lens or of its capsule, obstructing vision.
CHALAZION	Circumscribed tumor or lump of the eyelid caused by inflammation of the Meibomian glands.
CHOROID	The vascular middle coat of the eyeball situated between the retina and the sclera. Its function is to nourish the retina.
CHORIORETINITIS	Inflammation of the choroid and retina.
CILIARY BODY	A ring-shaped structure situated behind the iris and composed largely of the ciliary muscle and the ciliary processes.
CILIARY MUSCLE	A ring-shaped muscle situated in the ciliary body. The chief function is accommodation, or focusing.
CILIARY PROCESSES	Vascular folds on the inner surface of the ciliary body. The ciliary processes produce the aqueous humor; they also give attachment to the zonular ligament which holds the crystalline lens in place.
CONJUNCTIVA	The mucous membrane lining the eyelids and the anterior part of the eyeball.
CONJUNCTIVITIS – VERNAL	Inflammation of the conjunctiva. "Spring catarrh" attributed to allergy.
CONVERGENCE	Inward direction of the eyes.
CORNEA	The transparent anterior part of the eyeball which covers the iris and pupil.

CRYSTALLINE LENS	A transparent, nearly spherical body situated behind the pupil and designed to focus the rays of light on the retina.
CYCLITIS	Inflammation of the ciliary body usually associated with either iritis or choroiditis, hence also called uveitis.
DACRYOCYSTITIS	Inflammation of the lacrimal sac.
DIABETES, or DIABETES MELLITUS	A disease characterized by increased production of urine and by the presence of increased sugar in the urine and blood. The chief symptom is excessive thirst.
DIABETIC RETINOPATHY	Abnormal changes in the fundus of a diabetic consisting of hemorrhages, minute aneurisms and exudates in the retina.
DIPLOPIA	Double vision of a single object usually caused by paralysis of one or more eye muscles. When one eye is covered, the diplopia is abolished.
DIVERGENCE	Outward deviation of the eyes.
EPIDEMIC ENCEPHALITIS	Inflammation of the brain, frequently occurring in epidemics, and caused by a specific virus.
EPISCLERITIS	Inflammation of the superficial coat of the sclera.
EXTRAOCULAR MUSCLES	The muscles which rotate the eyeball into the various directions of gaze. Each eye has four straight and two oblique muscles.
FIELD OF VISION	The totality of objects visible at any one time, in direct and indirect vision without moving the eye. Other terms used, though scientifically inexact, are "side vision" and "peripheral range of vision."

FORNIX	The vaulted fold of the conjunctiva where it is reflected from the inner surface of the eyelids to the front surface of the eyeball. There are two fornices, the upper and the lower.
FOVEA	The central area of the retina affording the most acute vision. Literally, the word is Latin for "pit" and refers to the small rodless depression in the retina seen under the microscope.
FUNDUS	The interior, back portion of the eyeball which may be seen with an ophthalmoscope.
GLAUCOMA	Abnormal tension and stretching of the eyeball caused by increased fluid pressure within the eyeball. When the excessive pressure acts on the blood vessels of the eye, there is congestion and pain; when it presses on the optic nerve and the retina, there may be progressive loss of field of vision.
GONIOSCOPY	Examination of the angle of the anterior chamber, using a special contact lens and illumination.
HERPES ZOSTER OPHTHALMICUS	Shingles — an inflammation of the ophthalmic division of the fifth nerve causing painful vesicular lesions in the cornea, iris, conjunctiva and eyelids.
HYPEROPIA	Also called "farsightedness"; abnormal shortness of the eyeball, which causes light rays to come to a focus behind the retina. This results in either indistinct vision or in excessive strain on the focusing muscles. Hyperopia is corrected by wearing convex lenses.
HYPERTENSION	Abnormally high arterial blood pressure.
HYPERTENSION INDICATOR	Instrument used to measure the indentation of the cornea. Valuable in screening for glaucoma.

IRIS	Opaque, colored, circular, muscular, contractile diaphragm suspended behind the cornea and in front of the crystalline lens. It encloses the pupil, the size of which is regulated by the contractions of the iris muscles. It excludes the entrance of any light except through the pupil.
IRITIS	Inflammation of the iris.
KERATITIS	Inflammation of the cornea.
– INTERSTITIAL	Inflammation of the middle layers of the cornea, often a result of congenital syphilis.
KERATOCONJUNCTIVITIS – PHLYCTENULAR – ACUTE EPIDEMIC	Pimples and ulcers on the cornea and conjunctiva. Severe form of contagious conjunctivitis caused by a virus.
LACRIMAL APPARATUS	A system of glands and ducts concerned with the production and drainage of tear fluid.
LACRIMAL GLAND	The almond shaped gland which secretes the tears and is located within the orbit below the outer part of the eyebrow.
LACRIMAL SAC	The enlarged upper portion of the naso-lacrimal duct.
LACRIMATION	Excessive tearing.
LEUKEMIA	A disease in which the blood contains an excessive number of white blood corpuscles (leukocytes).
LEVATOR MUSCLE	The muscle which elevates the upper eyelid.
LYMPHATIC SYSTEM	The system of lymph nodes and lymph vessels.
MACROPSIA	Abnormality of vision in which objects appear larger than they really are.

MACULA LUTEA	"Yellow spot," the small area of the retina surrounding the fovea which is the spot where vision is most acute.
MEIBOMIAN GLANDS	Subacute follicles between the tarsus and conjunctiva in the upper and lower eyelids.
MICROPSIA	Abnormality of vision in which objects appear smaller than they really are.
MYOPIA	Nearsightedness, usually caused by an excessively long eye. The rays from distant objects are brought to a focus before they reach the retina. Vision is blurred because the image formed on the retina is out of focus.
NASAL SEPTUM	The structure in the nose which divides the nasal cavity into two cavities.
NICTALOPIA	A condition of the eyes in which the person can see well during the day or in a strong light but sees poorly at night or in dim light. Also called night blindness.
OCULIST OR OPHTHALMOLOGIST	Terms used interchangeably: —a physician who is qualified in the medical and surgical treatment of diseases and defects of the eye.
OPHTHALMIA NEONATORUM	Conjunctivitis and keratitis of the newborn usually caused by gonococcus.
OPTIC ATROPHY	Degeneration of the optic nerve.
OPTIC DISC	The disc shaped area which marks the exit of the optic nerve from the eyeball. Also known as optic nerve head.
OPTIC NERVE	The special nerve of the sense of sight.
OPTIC NEURITIS	Inflammation of the optic nerve.
OPTICIAN	One who makes or dispenses eyeglasses and who fills prescriptions for glasses. Distinguish from oculist; ophthalmologist; optometrist.

OPTOMETRIST	One skilled in the measurement of refraction of the eye for prescription of glasses and in visual training; not a physician.
ORBIT	The pyramidal shaped cavity, formed by several bones, which houses the eyeball together with a cushion of fatty tissue, the muscles of the eye and the optic nerve. In its apex, or deepest portion of the orbit, there is a hole, the optic foramen, through which the optic nerve passes to the brain.
PAPILLEDEMA	Swelling of the optic nerve.
PHOTOPHOBIA	Abnormal intolerance to light.
POSTERIOR CHAMBER	Space behind the iris which is filled with aqueous.
POSTERIOR SYNECHIAE	Adhesions between the pupillary border of the iris and adjacent structures, especially the lens.
PRESBYOPIA	Lessening of the power to adjust the focus for near vision. It is caused by increasing loss of elasticity of the crystalline lens and is noted especially in adults after 40 years of age.
PUNCTUM	Minute openings at the nasal corner of the upper and lower eyelids through which tear fluid is drained off.
PUPIL	The central black opening in the iris for the passage of light rays into the interior of the eyeball.
REFRACTION	Measurement and determination of the optical or refractive power of the eye and the correction of optical defects by the use of glasses.
RETINA	The innermost "seeing" coat of the eyeball comprised of light sensitive nerve cells and fibers which connect with the nerve fibers of the optic nerve.

RETINITIS PIGMENTOSA	A degeneration of the retina characterized by night blindness, typical pigmentation of the retina and tendency to hereditary transmission.
RETINOPATHY	A disease of the retina due to various causes, not inflammatory in nature.
RETROBULBAR NEURITIS	Inflammation of the optic nerve back of the eyeball.
RETROLENTAL FIBROPLASIA	An abnormality of the eyes found chiefly in premature infants with birth weight under two pounds and frequently resulting in blindness. The condition was found to be caused by an excessive administration of oxygen to the infant during the period of artificial incubation.
SCLERA	The tough outermost coat of the eyeball.
SCLERITIS	Inflammation of the sclera.
SQUINT OR STRABISMUS	Abnormal turning of one eye away from the parallel position. Squint is convergent when the eye turns inward toward the nose, divergent when the eye turns outward toward the temple (walleyed).
SYMPATHETIC OPHTHALMIA	Inflammation of the healthy eye subsequent to an injury of the other eye.
SYSTEMIC DISEASES	Diseases of the general system, or the body as a whole.
TARSUS	A dense fibrous plate which gives shape to the eyelid. In the upper eyelid, the levator muscle which raises the eyelid, is attached to the upper edge of the tarsus.
TONOMETER	A delicate instrument used to measure the ocular tension. It is important in the detection of glaucoma.

TOXOPLASMOSIS	A disease caused by a unicellular animal parasite, toxoplasma.
UVEA	The vascular middle coat of the eyeball. The uvea consists of three structures which are from behind forward, the choroid, ciliary body and iris.
UVEITIS	Inflammation of the uvea or any portion of it.
VITREOUS	The transparent colorless gelatinous mass which normally is contained in the part of the eyeball behind the lens and iris.

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